U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

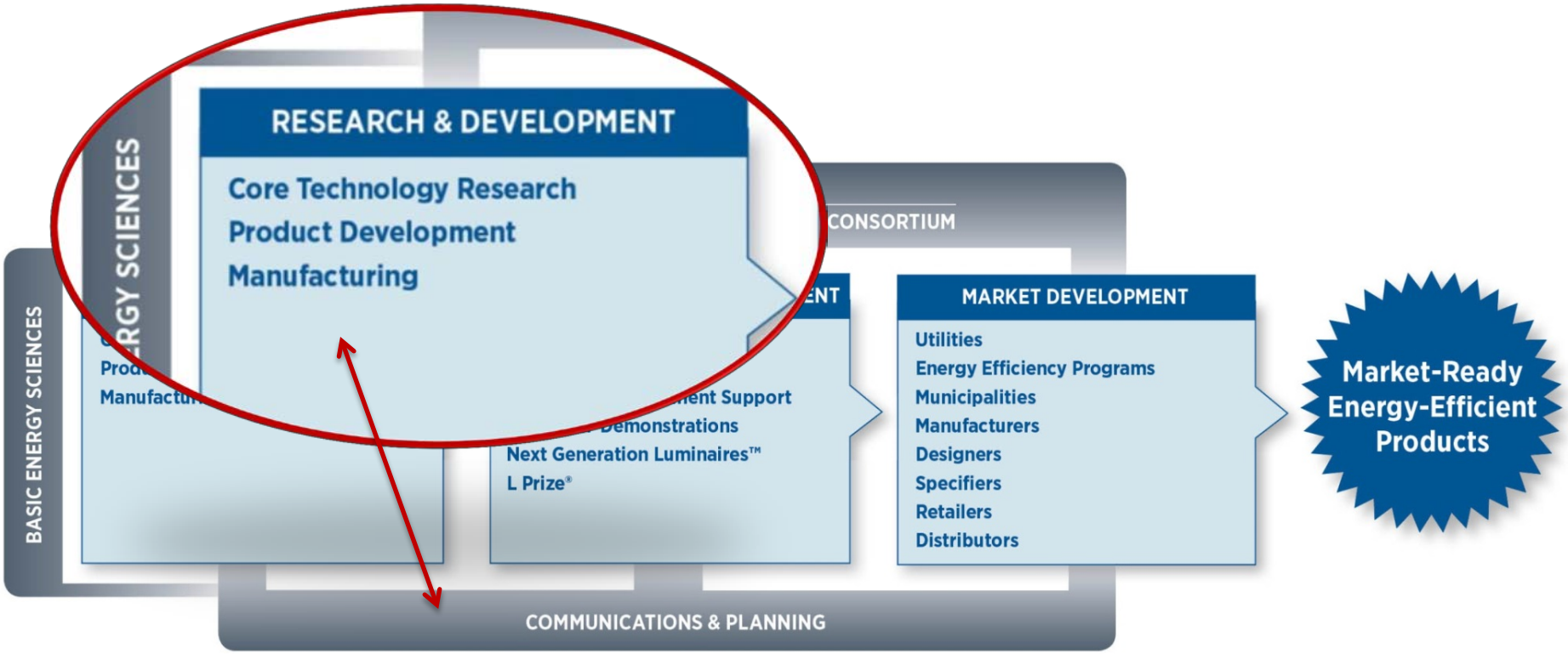
2014 Solid-State Lighting R&D Workshop

A Broader Look at Government SSL Support

January 29, 2014

Joel Chaddock
National Energy Technology Laboratory

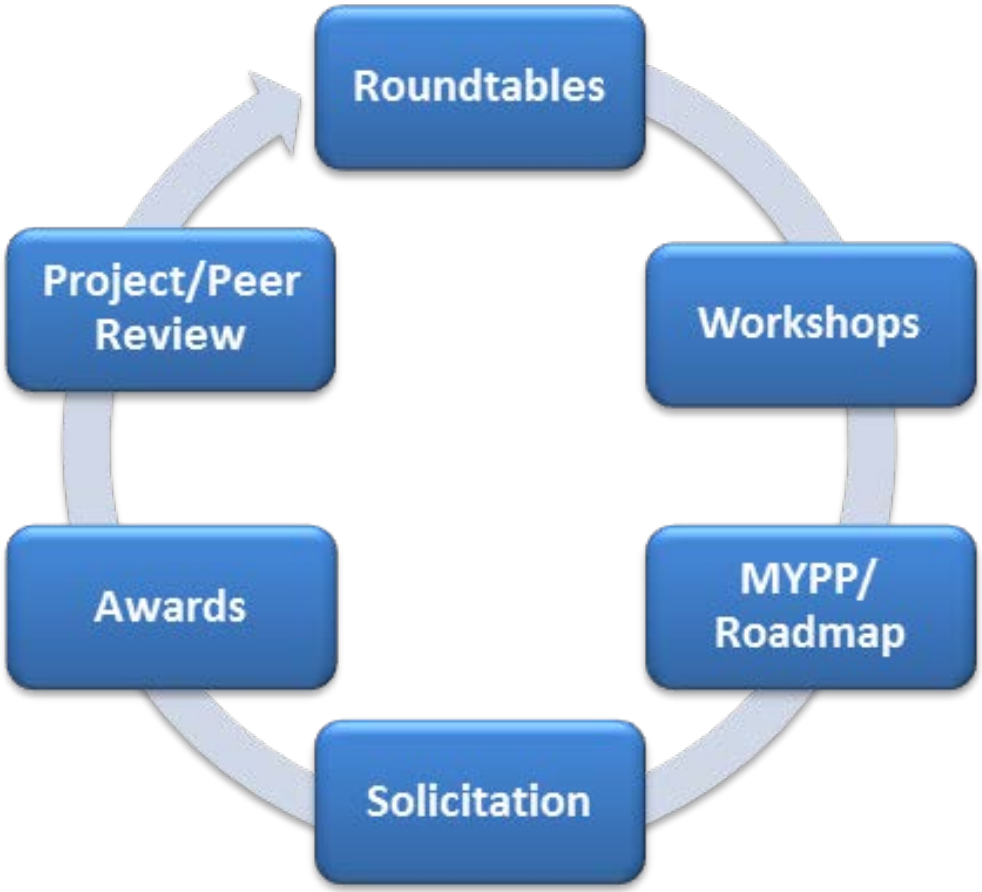
DOE Program Leadership Shapes SSL R&D



www.ssl.energy.gov/projects.html

Strategic Vision Defined in MYPP and Roadmap

- Industry input from Roundtables and Workshops shape MYPP/Roadmap priorities and DOE solicitations



Solicitation Goals

- Maximize the energy-efficiency of SSL products in the marketplace
- Remove market barriers through improvements to lifetime, color quality, and lighting system performance
- Reduce costs of SSL sources and luminaires
- Improve product consistency while maintaining high quality products
- Encourage the growth, leadership, and sustainability of domestic U.S. manufacturing within the SSL industry

SSL Program Guides Many Related Government Efforts

- Collaboration, coordination create a bridge between related efforts

SSL Program R&D, Market Development Support

Small Business Innovation Research (SBIR) Program

Energy Frontier Research Centers (EFRCs)

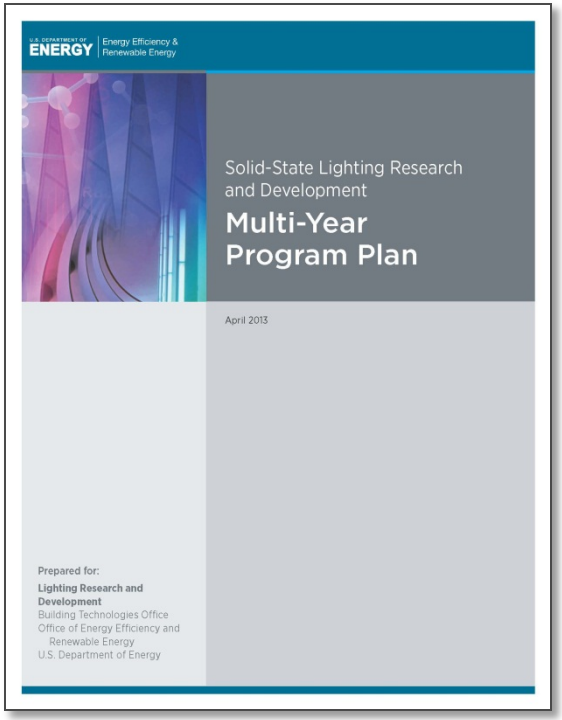
Advanced Research Projects Agency-Energy (ARPA-E)

Advanced Manufacturing Office

National Science Foundation SBIR Program

Core Technology Research

- Applied research to fill SSL technology gaps, provide enabling knowledge or data
- Particular emphasis on meeting technical targets for performance and cost
- Funded by SSL Program
- Guided by Multi-Year Plan priorities and targets



www.ssl.energy.gov/projects.html

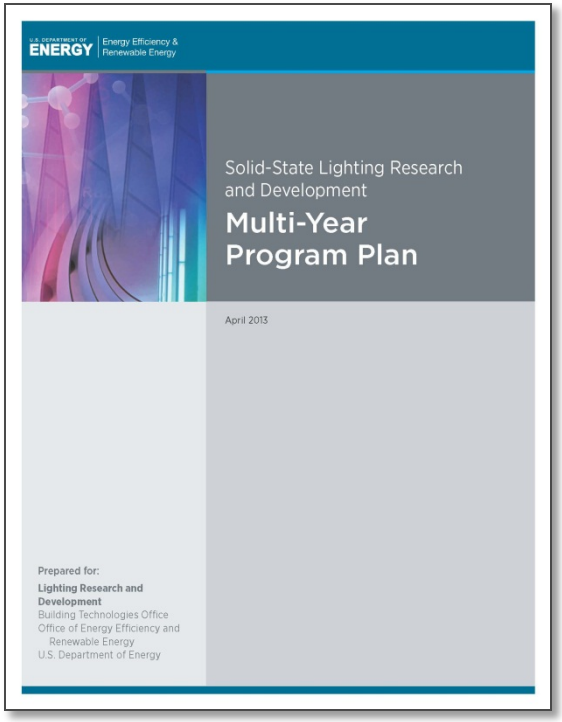
Core Technology Research

Look for these posters:

- **Poster 1:** High Efficiency and Stable White OLED using a Single Emitter (Arizona State University)
- **Poster 6:** High Efficacy Green LEDs by Polarization Controlled MOVPE (Rensselaer Polytechnic Institute)
- **Poster 7:** Lattice Mismatched GaInP Alloys for Color Mixing White Light LEDs (National Renewable Energy Laboratory)
- **Poster 10:** Low-Cost, Highly Lambertian Reflector Composite for Improved LED Fixture Efficiency and Lifetime (WhiteOptics)
- **Poster 24:** Light Emitting Diodes on Semipolar Bulk GaN Substrate with IQE > 80% at 150 A/cm^2 and 100°C (Soraa)

Product Development

- Use of applied research to develop or improve commercially viable SSL materials, devices, or systems
- Focus on a targeted market application with fully defined price, efficacy, and other performance parameters
- Funded by SSL Program
- Guided by Multi-Year Plan priorities and targets



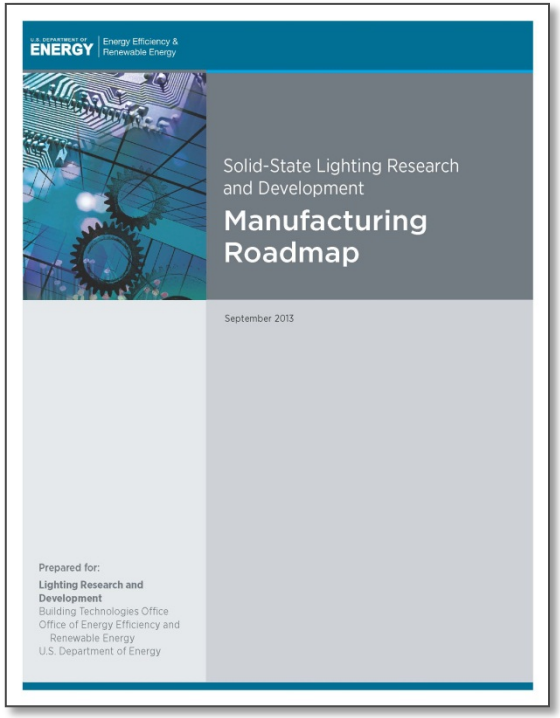
Poster 9:

High Power Warm White Hybrid LED Package for Illumination (Philips Lumileds Lighting)

www.ssl.energy.gov/projects.html

Manufacturing R&D

- R&D to achieve cost reductions through improvements in manufacturing, while maintaining or enhancing performance
- Focus on significant leaps in SSL manufacturing equipment, processes, or monitoring techniques, and on fostering U.S.-based manufacturing
- Funded by SSL Program
- Guided by Manufacturing R&D Roadmap
- Focus of separate workshop, May 7–8, 2014



www.ssl.energy.gov/projects.html

FY14 SSL Program FOA

- One FOA covers all three areas: Core Technology, Product Development, and Manufacturing R&D
- New process to streamline timing and feedback

New FOA Process	
FOA released	December 6, 2013
Webinar	December 13, 2013
Concept papers	January 8, 2014
Webinar	February 2014
Applications	February 24, 2014
Selection announcement	June 2014

Market Development Support

- Strategic efforts designed to overcome barriers to market adoption
- Closely coordinated with R&D progress to ensure appropriate applications, avoid buyer dissatisfaction
- Funded by SSL Program
- Guided by Market Development Support Plan
- Focus on separate workshop, November 11–13, 2014
- Testing, demonstrations, and analysis expand our knowledge base

www.ssl.energy.gov/market.html

Market Development Support

Studies and reports present objective market and technical analysis

- **Poster 18:** Adoption of Light-Emitting Diodes in Common Lighting Applications—Snapshot of 2013 Trends (Navigant)

Design competitions drive innovation, draw attention to well-designed products

- Check out the **Next Generation Luminaires™ exhibits**

Workshops, roundtables, working groups identify needs, address critical issues

- Reliability Consortium and RTI efforts, see **Poster 2:** System Reliability Model for SSL Luminaires (RTI International)

Small Business Innovation Research

- Annual solicitations increase participation of small businesses in federal R&D, include topics related to SSL
- Funded by DOE Office of Science, Basic Energy Sciences Program
- Research topics identified by SSL program, grants managed by SSL program

Poster 4: Dielectric Printed Circuit Board Planar Thermosyphon (Advanced Cooling Technologies)

Poster 5: Low Cost Printed Electrodes for OLED Lighting (Plextronics)

Small Business Innovation Research

Poster 11: Solutions for OLED Lighting (Universal Display Corporation)

Poster 12: Highly Efficient and Smart Power Supplies to Drive Phosphorescent OLED Lighting Panels (InnoSys)

Poster 13: A Novel OLED Luminaire System for Specialty Lighting Applications (Litecontrol)

Poster 22: Low Cost, Scalable Manufacturing of Microlens Engineered Substrates (MLES) for Enhanced Light Extraction in OLED Devices (Sinmat)

Energy Frontier Research Centers

- Support fundamental, longer-horizon energy research
- EFRCs with SSL R&D include: UCSB, USC, Sandia, CalTech, Carnegie Institution, MIT, LANL, U of Michigan
- Funded by DOE Office of Science, Basic Energy Sciences Program
- 2011 EERE/SSL and OS/BES Roundtable on science challenges
  - www.ssl.energy.gov/techroadmaps.html

Poster 17: Breakthrough Basic Research on the LED Droop Mechanism (University of California, Santa Barbara)

Poster 20: Laser Diodes for Solid-State Lighting (Sandia National Laboratories)

Poster 21: Revealing the 3-D Structure of Nanowire LEDs (Northwestern University)

http://science.energy.gov/bes/efrc

Advanced Research Projects Agency — Energy

- Supports high-potential energy-related R&D considered "too early" for private investment
- Includes topics related to SSL

Poster 8: Ammonothermal Bulk GaN Crystal Growth for Energy Efficient Lighting (Soraa)

Poster 15: Metacapacitors for LED Lighting (CUNY Energy Institute)

Poster 16: Advanced Power Electronics for LED Drivers (MIT)

Advanced Manufacturing Office

Invests in innovative technology, shared infrastructure and facilities, and education and workforce development in support of the President's Advanced Manufacturing Partnership

- Innovative manufacturing institutes focus on development of transformational manufacturing technologies
- New institute in North Carolina focuses on wide bandgap semiconductor-based power electronics
  - Applicable to multiple industries including SSL

National Science Foundation

- Additional funding for SBIR projects
- More on this from Steve Konsek

Poster 14: Thin-film Silicon Transistors Monolithically Integrated with LED Devices (Lumiode)

Poster 19: Silicon Nanoparticle Phosphors for LED General Illumination (LumiSands)

http://www.nsf.gov/eng/iip/sbir

DOE SSL Program Provides National Leadership

- SSL Program is a collaborative, cooperative partnership — with the lighting industry, research community, national labs, and market sector partners
- DOE Multi-Year Plan provides guidance for:
  - Various DOE efforts
  - U.S. and global efforts
- This is your opportunity to participate
  - More on this from Fred Welsh
- Sign up for regular updates on SSL Program activities

www.ssl.energy.gov